



Development of a Dedicated LPG Ultra-Low Emission Vehicle (ULEV)

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Performance Period

1/94-10/96

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Objective

To develop a dedicated propane vehicle that will meet or exceed the 1998 California ULEV emission standards.

Approach

Use the following technologies to develop a liquefied petroleum gas (LPG) gaseous fuel management system for a 1994 Dodge Intrepid 3.3-liter 60° V6:

- Port propane vapor injection
- High-pressure propane vapor regulation
- 32-bit electronic control module (ECM)
- Air Mass sensing



Propane (LPG) ultra-low emission vehicle

- Specially formulated three-way propane catalytic converters.

Integrate these technologies over four phases of development:

Phase 1	Systems Design
Phase 2	Hardware Assembly and Prototype Testing
Phase 3	Full-Scale Systems Testing and Integration
Phase 4	Vehicle Demonstration

After completing Phase 4 and accruing at least 10,000 miles, we will submit the test vehicle for independent verification of performance in meeting or exceeding the 1998 ULEV standards.

Accomplishments

Baseline 1994 Federal Test Procedure (FTP) gasoline emissions tests on the vehicle were completed September 8, 1994. A limited prototype LPG gaseous fuel port injection system was installed onto a 1994 3.3-liter V6 port-injected gasoline engine and tested on an engine dynamometer comparing horsepower and torque. Additional air:fuel ratio control cylinder-to-cylinder balance testing was also performed, which identified the need for proper port-injection timing for the gaseous fuel



being injected. System calibration and Federal Test Procedure (FTP) emissions testing were completed March 27, 1996. The vehicle is now going through Phase 4 Vehicle Demonstration (10K mile durability cycle).

Future Direction

After completion of Phase 4 Vehicle Demonstration (10K mile durability cycle), overall system performance, and final FTP, emission results will be evaluated. Design improvements to the product will then be determined, enabling planning for commercialization of the system components.

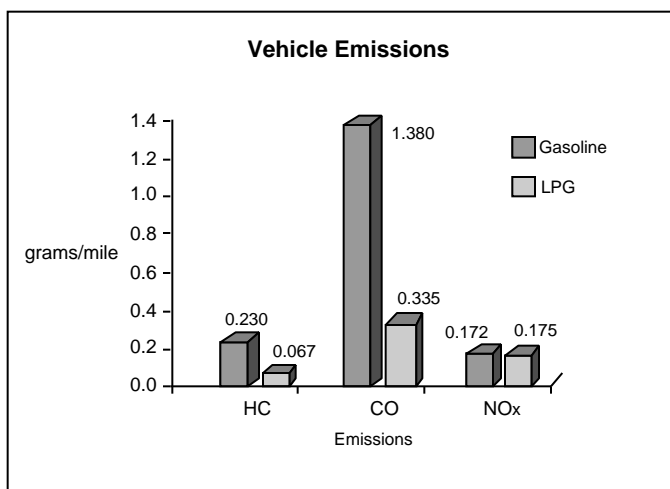
Publications

Smith, D.A., S. Stromberg, L. Gettel. 1994. "Dedicated Propane Ultra-Low Emission Vehicle." Presented at the Contractors Coordination Meeting, Detroit, MI. October.

Stromberg, S. et al. 1995. "Hardware Assembly and Prototype Testing for the Development of a LPG Ultra Low Emission Vehicle". Impco Technologies. NREL/TP-425-7618. July.

Measured Emissions (grams/mile)

Date		HC	CO	NOx	Fuel Economy (miles/gallon)
Sept 8 1994	Gasoline	0.230	1.380	0.172	16.74
(FTP emissions base line before vehicle modification to LPG)					
March 27 1996	LPG	0.067	0.335	0.175	14.59
(FTP emissions after modification to LPG prior to 10K mile durability phase)					



1998 California ULEV Emissions Standard for Light Duty Vehicle (grams/mile)

	HC	CO	NOx
50,000 mile	0.040	1.700	0.200
100,000 mile	0.055	2.100	0.300

Note: For propane, California ARB is proposing a reactivity factor of 0.47, so that ULEV HC standards will be 0.085 g/mile and 0.117 g/mile.